SANTA MONICA BAY SHORELINE MONITORING ASSESSMENT REPORT (July 1, 2002 – June 30, 2003) Monitoring and Assessment by the City of Los Angeles

I. INTRODUCTION

Santa Monica Bay is an important economic resource due to coastal tourism and recreational uses such as swimming, surfing, diving, sport fishing, and boating. It is known that exposure to polluted bodies of water during recreational use is associated with disease (Cabelli et al. 1982; Dadswell 1993; Van Asperen et al. 1995; SMBRP 1996). Therefore, ensuring the safety of Santa Monica Bay for recreational use is a significant public health issue. To improve public health conditions, regulatory agencies, wastewater dischargers and environmental groups undertake efforts such as increasing public awareness, drafting legislation, and monitoring the coastline.

The City of Los Angeles began bacteriological monitoring of Santa Monica Bay's shoreline waters on a regular basis in the mid-1950's to assess water quality in areas used for water-contact recreation. Originally, monitoring was conducted to detect contamination resulting from the Hyperion Treatment Plant's (HTP) wastewater. Since HTP installed the 5-Mile Outfall, extensive monitoring has shown that the Hyperion wastewater plume does not reach the shoreline of Santa Monica Bay (CLA, EMD 2002). Bacterial contamination persisted; however, leading to the realization that urban runoff is a significant source of bacterial contamination along the beaches of Santa Monica Bay. This recognition resulted in a joint effort involving the City of Los Angeles, Heal the Bay, and the Los Angeles Regional Water Quality Control Board, in 1995, to relocate the 18 shoreline stations close to storm drains and/or popular recreational areas.

Urban runoff is the largest nonpoint source of pollution to Santa Monica Bay. Urban runoff has two major origins: rainfall and street runoff. Street runoff can result from domestic, commercial, and industrial activities, and irrigation water. Runoff reaches Santa Monica Bay through approximately 70 storm drains that empty directly into the Bay or flow onto the beach and then into the Bay. Runoff occurs daily in some storm drains; it has been estimated that Santa Monica Bay receives a flow of 10-25 million gallons per day from storm drains during dry weather (SMBRP 1996). During rain events, the concentrations of pollutants (heavy metals, human and animal wastes, petroleum- and automobile-based chemicals) are more dilute, but the mass loading is much larger due to wash-down effects of the rain on the surrounding urban environment.

Measures to mitigate street runoff contamination have come in the form of public education, source identification and elimination, and storm drain flow diversion structures. The City of Los Angeles Watershed Protection Division has embarked on pollution-abatement measures by developing and constructing low-flow diversion structures to divert urban runoff from problematic areas in the City to the Hyperion Treatment Plant for treatment during the dry-weather season. Thus far, 12 low-flow diversions have been completed, and ten more are under construction or design.

Santa Monica Bay shoreline stations and major storm drains are sampled on a routine basis throughout the year to monitor the influence of urban runoff on the bacteriological water quality of Santa Monica Bay. Bacteriological data collected from July 1, 2002 through June 30, 2003 at these sampling locations are summarized herein.

To evaluate the bacterial component of water quality, three bacterial subgroups are analyzed and quantities compared to AB411 standards (Table 1). The subgroups include total coliforms, fecal coliforms or *Escherichia coli (E.coli)* bacterial species, and enterococci. The quantification of these indicator bacteria provides an assessment of public health hazards associated with microorganisms, given the conventional methods of analyses.

Table 1. AB411 Bathing Standards

Density of Bacteria on a Single Sample Shall Not Exceed:
▪ 10,000 total coliform bacteria/100mL; or
▪ 400 fecal coliform bacteria/100mL; or
▪ 104 enterococcus bacteria/100mL; or
▪ 1,000 total coliform bacteria/100mL, if ratio of fecal/total coliform exceeds 0.1

When one of the four bathing standards is exceeded, L.A. County health officials and lifeguards are required to initiate measures to publicly notify beach goers of the exceedance and the severity of the contamination. Warning signs advising the public of the potential health risk associated with swimming in the contaminated water are placed at the affected areas. The beaches remain open to the public, but beach-goers may choose to heed the warning on the basis of their own personal comfort level of the risk. However, when a sewage spill occurs, the impacted beach is closed to the public for at least 72 hours after the source has been identified, and is re-opened after the spill is eliminated and the sampling results demonstrate compliance with state standards.

The Los Angeles County Municipal Separate Stormwater Sewer System (MS4) permit provides for the use of either the Membrane Filtration method or the Idexx Chromogenic Substrate method for analysis of bacterial indicators. The Membrane Filtration method tests specifically for total coliforms, fecal coliforms and enterococci, whereas Idexx Chromogenic Substrate tests for total coliforms, *E. coli*, and enterococci. In addition, the former allows for a faster turnaround time in processing and testing the samples, as a result, leads to earlier data submission to the Los Angeles County Department of Health Services (LACDHS). Total coliform and *E. coli* results can be made available to the LACDHS within 18 hours instead of 24 hours, thereby providing the public with earlier notification on the water quality of their beaches and decreasing public health risk.

Because the Idexx Chromogenic Substrate method tests for *E. coli* rather than fecal coliforms (an indicator that has a significant amount of historical data associated with it in regards to receiving water monitoring), issues arose regarding the validity of using *E. coli*. During 2001-2002, the City of Los Angeles Environmental Monitoring Division (CLA EMD) conducted a study assessing the comparability of these two methods when testing receiving waters. The study (unpublished) found that the numbers were indeed comparable, showing a strong linear correlation (nearly a 1:1 ratio) for total coliform and fecal coliform/*E. coli*. Also, the use of *E. coli*, a subset of fecal coliform, should not compromise public health due to the fact that *E. coli* is the predominant organism found in this group of bacterial indicators.

The Idexx Chromogenic Substrate method was implemented for analyzing total coliform and *E. coli* on shoreline samples only. Parallel testing for enterococcus bacteria was conducted using both Membrane Filtration and Idexx Chromogenic Substrate, and continued into 2003. Because the Idexx Chromogenic Substrate method was not yet approved for enterococcus, only Membrane Filtration results were reported. Data assessment will follow pending completion of the study to determine the correlation between enterococcus results obtained from Membrane Filtration and Idexx Chromogenic Substrate. The study will also investigate the rate of false positives that are observed using Idexx Chromogenic Substrate for enterococcus analysis and its role in the increased number of exceedences for this indicator.

II. MATERIALS AND METHODS

A. SAMPLE COLLECTION

Water samples from 18 Santa Monica Bay shoreline stations were collected daily. Shoreline stations ranged southward from Surfrider Beach in Malibu to Malaga Cove in Palos Verdes (Figure 1). All shoreline stations are sampled 50 yards away from where the storm drain flow meets the shoreline, if applicable. Otherwise, samples are taken 50 yards from a pier or jetty (with the exclusion of station S9 and S18). All samples were collected at ankle-depth level during daylight hours.

B. SAMPLE ANALYSIS

Water samples were collected and analyzed according to Standard Methods (APHA 1992). Total coliform, fecal coliform, and enterococcus bacterial densities were determined by membrane filtration as recommended in sections 9222B, 9222D, and 9230C from July 1 through December 1, 2002. Beginning December 2, 2002 the chromogenic method was employed to analyze samples for total coliform and *E. coli* following Standard Methods sections 9223 (APHA 1992) but the membrane filtration method was maintained for analyzing samples for enterococcus. Samples were tested daily for total and fecal coliforms/*E. coli* and five times a month for enterococcus bacteria.

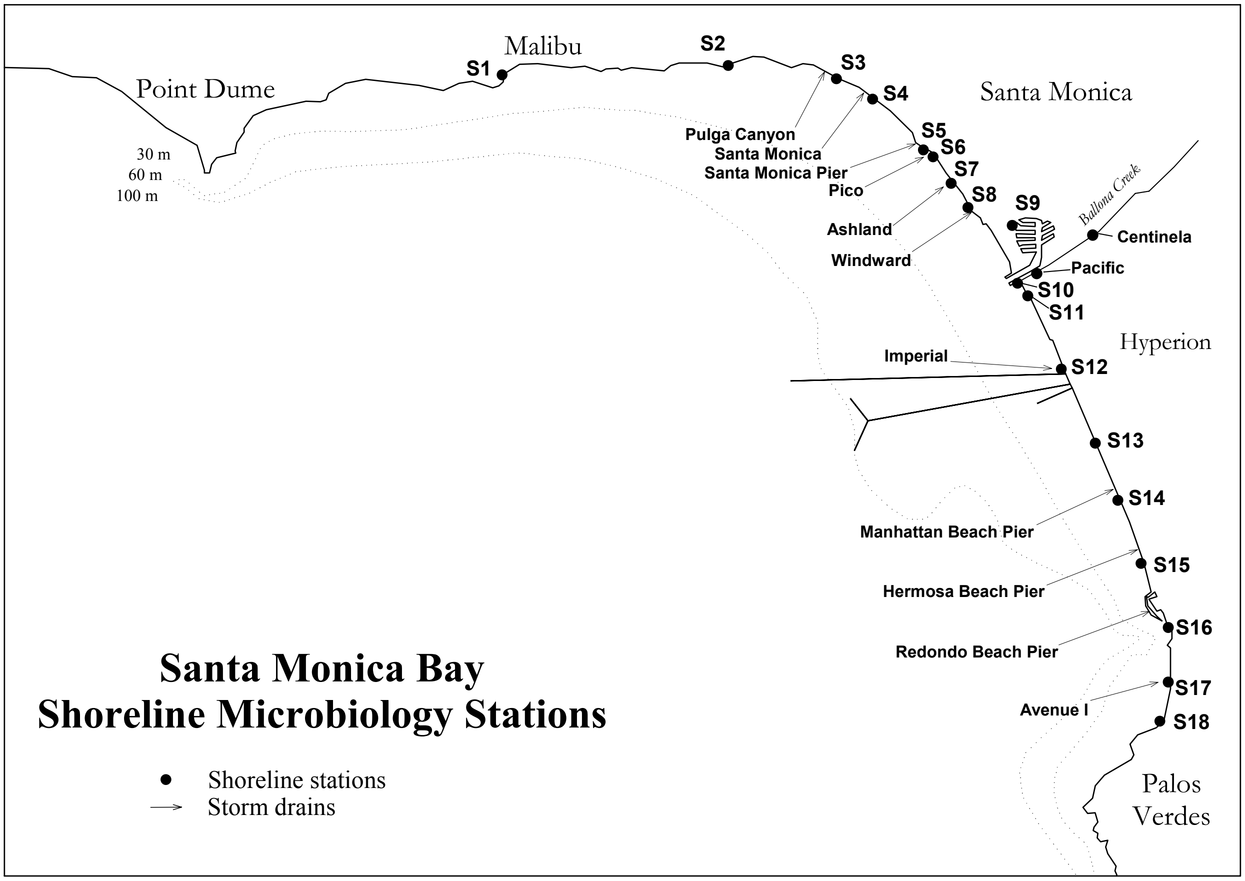

Figure 1. Location of Santa Monica Bay shoreline microbiology stations, stormdrains, and piers.

Quality assurance and quality control procedures were conducted to confirm the validity of the analytical data collected. All areas impacting reported data were subjected to standard microbiological quality control procedures in accordance with Standard Methods (APHA 1992). These areas included sampling techniques, sample storage and holding, facilities, personnel, equipment, supplies, media, and analytical test procedures. Duplicate analyses were also performed on ten percent of all samples. When quality control results were not within acceptable limits, corrective action was initiated. This quality assurance program helped ensure the production of uniformly high quality and defensible data. In addition, EMD participates annually in the performance evaluation program managed by the California State Department of Health Services

(CSDHS). As part of their Environmental Laboratory Accreditation Program (ELAP), CSDHS biennially certifies EMD.

C. DATA ANALYSIS

The results obtained from microbiological samples are generally not normally distributed. To compensate for a skewed distribution and to obtain a nearly normal distribution, data must be log-normalized prior to analysis. Geometric means are the best estimate of central tendency for log-normalized data and were calculated for each bacterial indicator group. Annual geometric means were calculated for all shoreline sampling sites.

Shoreline data were divided into periods of wet and dry weather to examine the effects of storm drain runoff on indicator bacterial concentrations. Regulatory agencies have defined wet weather as the day of rain plus two days following the rain event. Rain data were obtained from the National Weather Service's Los Angeles Civic Center monitoring station.

III. RESULTS

Rainfall

There were eight months with measurable rainfall during the 2002-2003 fiscal year with February 2003 receiving the most rain (4.64 inches), almost one-third of the total rain for that period (Figure 2). Most of the rain was concentrated during the wet-weather season (November 1-March 31), comprising approximately 90% of the total rainfall for the fiscal year (16.43 inches), slightly greater than the annual average of 15 inches for Los Angeles.

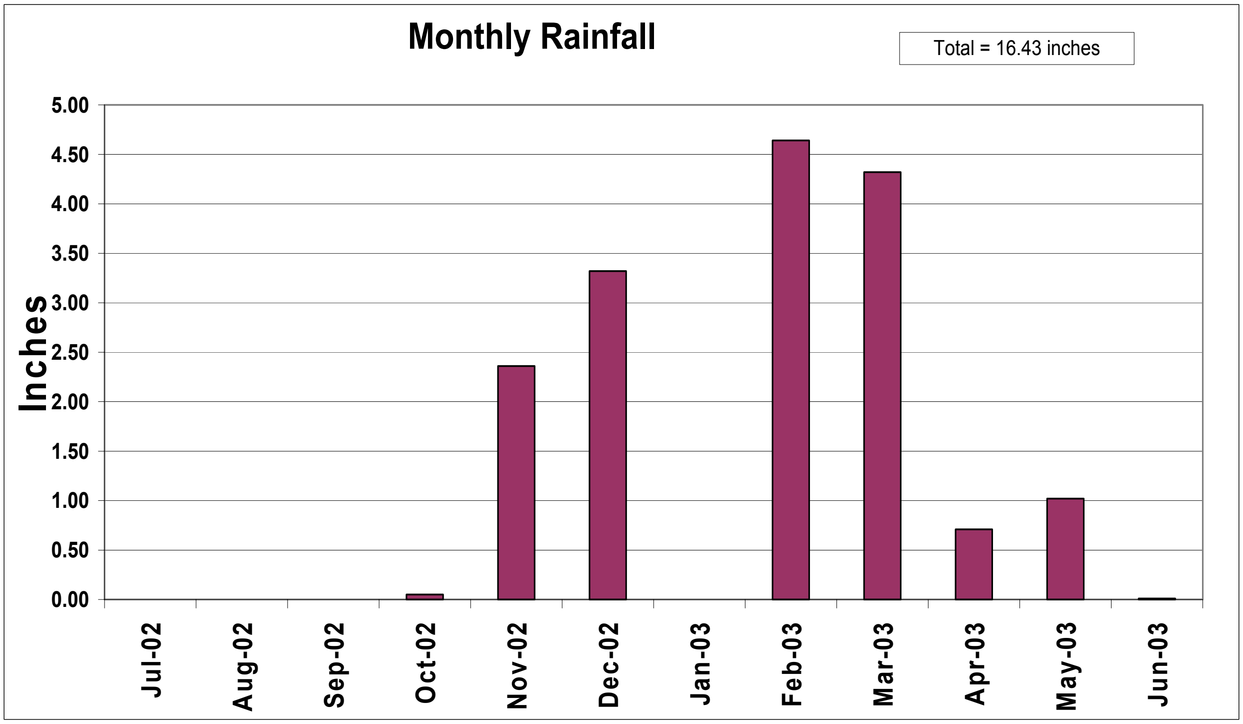

Figure 2. Monthly rainfall amounts at Los Angeles Civic Center, July 2002-June 2003.

Shoreline Stations

The annual geometric means for all indicator bacteria during wet weather were higher than those observed during dry weather (Figure 3). The highest bacterial densities during periods of dry weather were often, but not always, found at stations associated with flowing storm drains or by those adjacent to piers (Figure 1). Stations S1 (Surfrider Beach), S4 (Santa Monica Canyon), and S5 (Santa Monica Pier) had the highest bacterial densities in the northern part of the Santa Monica Bay (SMB) and Stations S10 (Ballona Creek) and S16 (Redondo Beach Pier) along southern SMB. As stated earlier, not all SMB stations are associated with flowing storm drains.

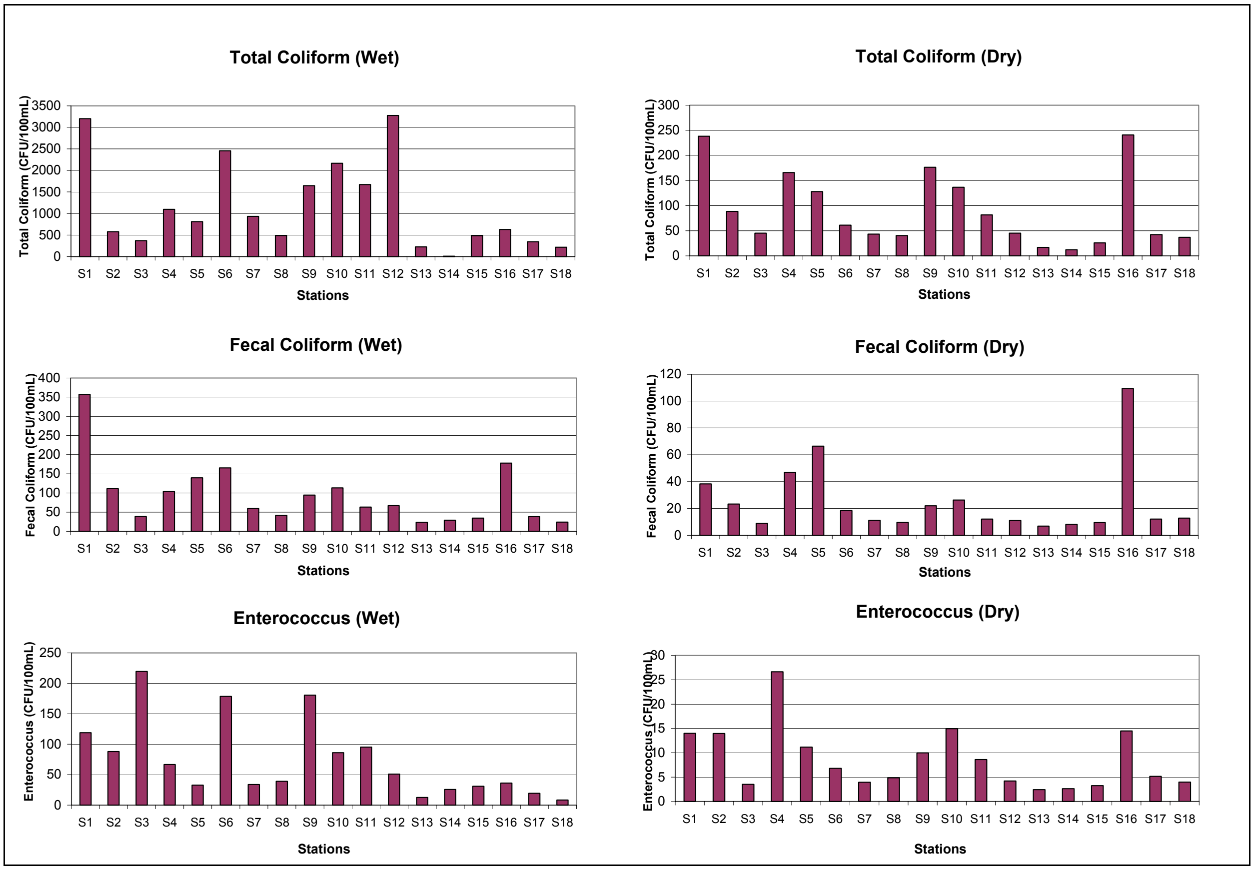

Figure 3. Annual geometric means for indicator bacteria at each shoreline station in Santa Monica Bay during wet and dry weather.

North Santa Monica Bay is comprised of stations located from Malibu (S1-Surfrider Beach) to Marina del Rey (S9-Mother's Beach). These northern SMB stations typically had higher bacterial geometric means than the southern section of the Bay for all indicator bacteria, with the exception of Station S16 for total and fecal coliforms/*E. coli* during the dry-weather season. In northern SMB, Station S1 exhibited the highest total coliform counts for dry-weather, wet-weather, and both weathers combined. The highest fecal coliform/*E. coli* densities during dry weather were measured at Station S5, while the highest enterococcus dry-weather densities were measured at Station S4. High counts were consistently measured for all bacteria during dry-weather at Stations S1, S2, S4, S5, and S9. Station S8 exhibited the lowest total coliform dry-weather geometric mean while

Station S3 had the lowest fecal coliform/*E. coli* and enterococcus dry-weather counts in the northern Bay.

The southern section of Santa Monica Bay include all of the stations south of Ballona Creek, starting from Station S10 (50 yards south of Ballona Creek) to Station S18 (Arroyo Circle, Palos Verdes). The bacterial densities measured at these stations were typically lower than those found in the northern section, with the exception of Station S16. During dry-weather, Station S16 has the highest fecal coliform/*E. coli* geometric mean for both seasons combined (Figure 3). The highest enterococcus dry-weather geometric mean in the south Bay was measured at Station S10. In contrast, the lowest total coliform dry-weather geometric mean was observed at Station S14 and the lowest fecal coliform/*E. coli* and enterococcus dry-weather geometric means were recorded at Station S13.

Water Quality Standards Compliance

A summary of AB411 bathing standards percent compliance for total coliform, fecal coliform/ *E. coli* and, enterococcus can be observed in Table 2. The percent compliances are based on dry-weather events to establish water quality. During the period of July 1, 2002 to June 30, 2003, there were two stations (S3 and S15) at which 100% compliance for three of the four AB411 standards was demonstrated, however, none of the 18 Santa Monica Bay stations, fully complied with all of the listed limits during the designated time period. Five stations situated along northern Santa Monica Bay (S1, S2, S5, S6, and S9) were not in compliance for any single standard. In addition, the lowest percent compliance for all the bathing water standards occurred at Station S1, meaning that the frequency of exceedences were highest at this station. In southern Santa Monica Bay, the compliance rate for any single standard was better than in the north, ranging from 93.2 to 99.7% at five stations (S10, S12, S16, S17 and S18). The lowest percent compliance in the southern section of the Bay occurred at Station 16.

Table 2. Percent compliance with AB411 standards during dry weather, July 2002-June 2003

Station	Total[1]	Fecal[2]	Entero[3]	T:F Ratio[4]
S01	93.2	81.6	80.4	87.7
S02	98.1	96.5	90.4	95.8
S03	100.0	99.4	100.0	100.0
S04	100.0	95.2	82.0	93.2
S05	99.7	90.0	94.1	95.8
S06	98.7	98.4	98.1	98.4
S07	98.1	100.0	98.0	100.0
S08	100.0	99.7	100.0	99.7
S09	99.7	95.5	96.2	93.9
S10	97.7	97.4	98.0	98.4
S11	98.7	99.4	96.2	100.0
S12	99.0	99.0	96.0	99.7
S13	99.7	99.7	100.0	100.0
S14	99.7	99.7	98.0	100.0
S15	100.0	100.0	100.0	99.7
S16	99.4	86.4	94.0	93.2
S17	97.7	99.0	94.0	99.7
S18	99.7	99.0	98.0	99.7

[1] 10,000 total coliform bacteria/100mL
[2] 400 fecal coliform bacteria/100mL
[3] 104 enterococcus bacteria/100mL
[4] Total coliform level greater than 1000 bacteria/100mL and *E.coli*:TC ratio is greater than 0.1

The percentage of samples exceeding any of the AB411 standards, regardless of weather, can be seen in Figure 4. The data presented in this figure takes into account periods of dry and wet weather combined. Station S1 far exceeds any of the other stations in Santa Monica Bay, followed by Station S16. The lowest percent exceedances in north and south SMB are Stations S8 and S14, respectively.

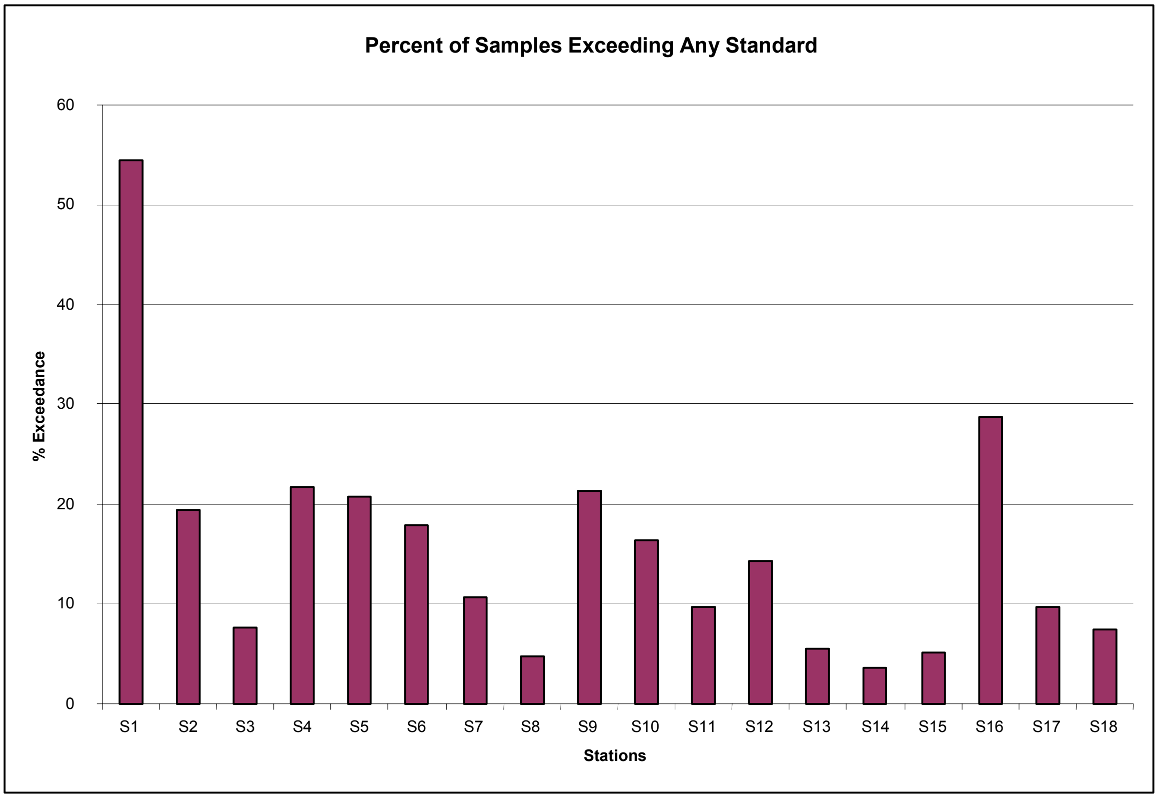

Figure 4. Percent exceedances of any of the four AB411 standards at SMB shoreline stations, dry- and wet-weather combined.

IV. DISCUSSION

In general, water quality in the Santa Monica Bay is good**.** Measurements of water quality at all monitoring sites remained within 80% - 100% in compliance with all four AB411 bacterial standards. This is a lower rate of compliance when compared to the last monitoring year (July 2001 – June 2002), 84% - 100%. Two factors affecting water quality at monitoring sites are rain events and proximity to storm drains and piers. This monitoring period was a wet year relative to the previous monitoring period, with the 16.43 inches of rain delivering substantially more runoff to the shoreline waters.

Urban and stormwater runoff are the biggest contributors of bacterial contamination to Santa Monica Bay. Runoff flows over rooftops, freeways, parking lots, construction sites, industrial facilities, and other impervious surfaces, collecting pollutants and transporting them through open channels and underground pipes directly to the Bay. Even in dry-weather, ten to twenty-five million gallons of water flow through storm drains into Santa Monica Bay every day (The Bay Commission 2003).

The northern part of the Bay contains the majority of consistently and intermittently flowing storm drains. Station S1, a popular recreational site for the surfing community, was consistently the site of highest indicator counts for wet weather, dry weather and wet-dry combined. It is the outlet of the entire Malibu Creek watershed and is mainly affected by flows from the Malibu Lagoon located 50 yards to the north. Malibu Lagoon flowed constantly from November 2002 to June 2003, with moderate flows in dry weather and moderate to heavy in wet weather. The lagoon is a repository for the Las Virgenes Municipal Water District's Tapia Water Reclamation Facility that periodically discharges tertiary-treated wastewater into the Bay via Malibu Creek (The Bay Commission 2003). The lagoon also serves as a reserve for numerous bird species, an added risk of contamination at this monitoring site.

In addition to Station S1, high counts were consistently measured at Topanga Canyon (S2), Santa Monica Canyon Storm Drain (S4), Santa Monica Pier (S5), and Mother's Beach (S9) for dry weather. Stations S2 and S4 are associated with stormdrains and flowed for 107 and 242 days of the monitoring period, respectively, with light to moderate flows (Figure 5).

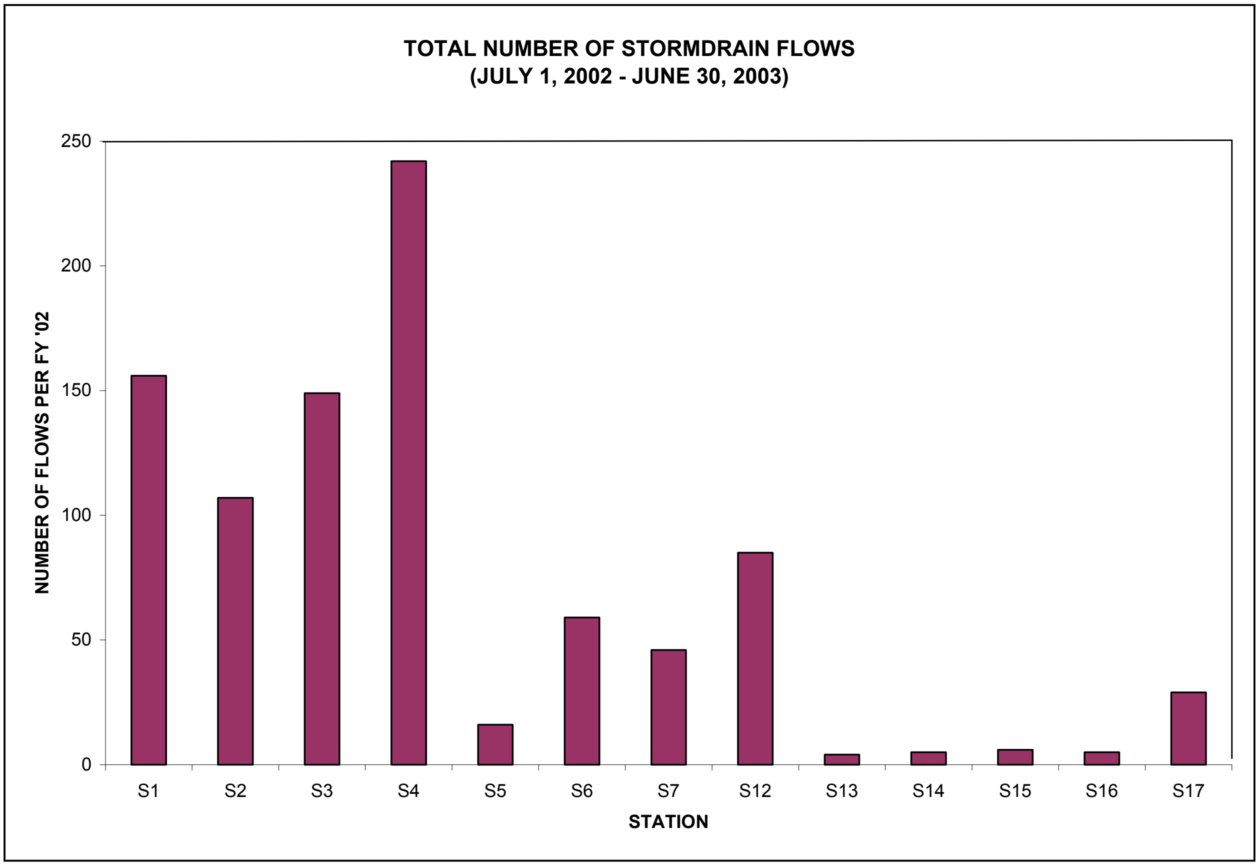

Figure 5. Number of days that flows from Santa Monica Bay storm drains were observed at monitoring stations.

Station S5 is located proximal to Santa Monica Pier. The storm drain located at the pier has been diverted to the Santa Monica Urban Runoff Recycling Facility (SMURRF) during dry weather. A more likely source of contamination at this station is the pier and attendant structures. Santa Monica Pier houses several food concession stands, restroom and parking facilities, as well as a small marine aquarium, and attracts thousands of California local visitors and tourists annually.

Station S9, located in Marina Del Rey at Mother's Beach, is not associated with any visible storm drain. However, Station S9 is located in an area of stagnant or low flow and poor circulation, resulting in slow flushing of contaminants out of the area. The site has been mitigated for possible avian fecal contamination by the installation of overhead filamentous wire structures (interfering with the fight path of birds) to prevent or reduce the presence of birds on the shore. Los Angeles County Department of Beaches and Harbor (LACDBH) has recently initiated a project to identify and eliminate contamination sources (Lauri Ames, LACDBH, personal communication). Additionally, this site has been included in the Santa Monica Bay bacterial TMDL program.

Storm drains in the southern portion of Santa Monica Bay, with the exception of those at Stations S10, S12, and S17 (Ballona Creek, Imperial Hwy, and Ave I storm drains, respectively), rarely exhibit visible flow in dry weather. Station S10 (Ballona Creek) exhibited the highest bacterial counts among the three storm drains mentioned.

Station S10 is adjacent to Ballona Creek which is one of the largest freshwater non-point sources to drain directly into the Bay. In 1987 and 1988, Ballona Creek accounted for 58% and 71%, respectively, of the total freshwater runoff into the Bay. Based on 1987-1988 observations, winter storm flow in the creek accounts for at least 50% of the total annual volume discharge into the Bay (Interdisciplinary Oceanographic Group 1998). This flow carries high concentrations of bacteria. For example, at Pacific Ave, EMD's monitoring site nearest to the mouth of Ballona Creek, an average annual geometric mean of 4200 cfu/100ml for total coliforms and 370 cfu/100mL for fecal coliforms, wet and dry weather combined, was measured. There can be little doubt that counts at Stations S10 and S11 are a reflection of the discharge from Ballona Creek, especially during wet weather when flows are increased. Most current measurements in Santa Monica Bay in the winter-storm period indicate a mean flow toward the northwest, but near-shore measurements indicate a southward flow along the coast. Such a southward flow in the Bay would advect plume waters from Ballona Creek toward the beaches of Playa del Rey (Interdisciplinary Oceanographic Group 1998). In addition to being subject to stormwater plumes from Ballona Creek, Station S11 is located adjacent to the Culver storm drain. However, impacts from flows through this drain are not effectively assessed because it extends too far into the surf to be visible to the monitoring staff for determining the level of activity.

Station S16, located at the far end of the southern portion of the Bay, is adjacent to Redondo Beach Pier and was found to have the highest dry-weather total and fecal coliform/*E. coli* counts along south Santa Monica Bay. This site, much like Station S5 (Santa Monica Pier), is subjected to similar influences of bacterial contamination. The pier contains a large restaurant, food concessions, restroom and parking facilities, and has a large tourist population. Though there is an associated storm drain in the area, it rarely flows across the sandy surface. The counts here can be attributed most likely to pier activity.

Water quality within the Santa Monica Bay has improved in recent years due to the efforts of the City/County of Los Angeles' Low-Flow Diversion Program, the City of Santa Monica's Sustainable City Program (SMURRF), and the efforts of other municipalities within the watershed in implementing several best management practices (BMPs) (Table 3). These programs are designed to prevent harmful pollutants from reaching our local water bodies, enhance economic development and growth through increased beach usage and tourism, and to protect human health and the environment. These programs are part of a continuing process to reduce or prevent discharge of harmful pollutants into the receiving waters of the Bay.

Table 3. Status and locations of the various Santa Monica Bay low-flow diversion projects.

No.	Drain	Drain Owner	Average Flow (MGD)	Construction Cost	Costruction Completion Date	Lead Agency
	Completed Projects					
1	Pico-Kenter	County of LA	0.04	$250,000	1-Jan-93	City of LA/City of SM/County of LA
2	SMURRF (Treats Pico-Kenter and Santa Monica Peir Drains diverted flows)	County of LA	0.04	$12 million	1-Oct-01	City of LA/City of SM
3	Ashland Avenue	County of LA	0.07	$300,000	15-Apr-01	County of LA
5	Rose Avenue (diverts into Ashland)	County of LA	0.04	--	15-Sep-77	County of LA
4	Brooks Avenue	County of LA	0.11	$300,000	15-Apr-01	County of LA
6	Playa del Rey	County of LA	0.26	$300,000	15-Apr-01	County of LA
7	Santa Monica Pier	City of SM	0.04	$75,000	1-Oct-97	City of SM
8	Thornton Avenue	City of LA	0.05	$550,000	22-Jun-99	City of LA
9	Bay Club Drive	City of LA	0.08	$390,000	24-Jan-01	City of LA
10	Palisades Park	City of LA	0.52	$480,000	28-Nov-00	City of LA
	Under Construction					
1	Santa Monica Canyon	County of LA	4.2	$1,200,000	10-Jun-03	City of LA
2	Venice Pavilion (Windward Ave Pump Station)	County of LA (City of LA)	0.1	$300,000	10-Jun-03	City of LA
3	Temescal Canyon	County of LA	1.3	$590,000	23-Jun-03	City of LA
4	Imperial Highway	County of LA	0.05	$510,000	29-Jun-03	City of LA
	Under Design					
1	Castlerock/Parker Canyon	County of LA	0.27	$800,000	1-Oct-03	County of LA [a]
2	North Westchester (Project No. 5241)	County of LA	0.34	$800,000	1-Sep-04	County of LA [a]
3	Santa Ynez Canyon (Project No. 674)	County of LA	1.7	$800,000	1-Dec-04	County of LA [a]
4	Pulga Canyon (Project No. 501)	County of LA	0.65	$800,000	31-Dec-04	County of LA [a]
5	Ashland Ave (Project No. 7401)	County of LA	0.1	$800,000	31-Dec-04	County of LA [1,a]
6	Rose Ave (Project No. 46)	County of LA	0.1	$800,000	31-Dec-04	County of LA [1,a]
7	Brooks Ave (Project No. 507)	County of LA	0.1	$800,000	31-Dec-04	County of LA [1,a]
8	Marquez Avenue	City of LA	0.03	$400,000	31-Dec-04	City of LA
	Future Projects					
1	Montana Avenue	County of LA	0.06	$1,000,000	1-Oct-03	City of SM [b]
2	Wilshire Boulevard	County of LA	0.11	$1,000,000	1-Oct-03	City of SM [b]

Note: Anticipated Bacterial TMDL adoption date is June 2003.
Summer dry weather bacterial TMDL compliance date is June 2006.
Winter dry weather bacterial TMDL compliance date is June 2009.

[1] Upgrade existing facilities or construct new facilities to replace existing

[a] The City of LA will coordinate the implementation of the project(s) with the County of LA.

[b] 100% of the drainage areas are within the City of SM.

Other measures for improving water quality along Santa Monica Bay beaches include (Santa Monica Bay Restoration Commission 2003):

- Structural Best Management Practices (BMPs), such as installation of in-stream trash capture devices, catchbasin retrofits, and installation of filtration devices along roadways or in parking lots.
- Non-structural BMPs, such as catch-basin stenciling, enhanced catch basin/trash can cleaning, and street sweeping,
- Public education and outreach
- Enhanced storm drain inspection
- Implementation of programs that eliminate illicit connection and illegal discharge to the storm drains
- Promotion and enforced implementation of BMPs at industrial facilities and construction sites
- Implementation of new land use practices to increase on-site storm water infiltration and to reduce erosion
- Enaction and enforcement of local ordinances that prohibit activities that contribute to storm water pollution, such as illegal disposal, dumping or washing of waste (from domestic animals, restaurants, automobiles, etc.) into the storm drain system.

Some of the above recommendations have already been implemented and, given the cooperative spirit of municipalities, environmental organizations, and concerned communities, more and more strides are made each year to enhance and protect our water bodies.

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